CLAIMS

1. Implementation process of a conversational rational agent as kernel of a dialogue system and/or as element (agent) of a multiagent system including the following stages

- definition of a conceptual architecture of a conversational rational agent,
- formal specification of the different components of this architecture and their combination permitting a formal model to be obtained,

characterized in that it includes the definition of a software architecture implementing the formal architecture, this definition consists in,

- a definition of mechanisms that implement the formal specification including:
- data including predefined axiom schemes and axiom schemes dependent on the desired application,
- a knowledge base dependent on the desired application including a semantic network and inter-concepts distances,
- an inference engine to implement formal specification mechanisms by means of data and the knowledge base in order to be able to receive a logical statement, understand it, and to be able to provide a logical statement in response,
- the rational agent is thus intended to converse with another agent or with a system user through any communications medium.

2. Implementation process according to the claim 1, characterized in that the definition of the software

architecture implementing the formal architecture is realized by a rational unit (100) containing a rationality axioms implementation layer, a communication axioms implementation layer, a cooperation axioms implementation layer, corresponding respectively to axioms predefined by the formal model.

3. Implementation process according to claim 1 characterized in that the definition of the software architecture implementing the formal architecture includes besides:

- a generation module (160) to transcribe a sequence produced by the rational unit (100) in a user's natural language statement and a comprehension module (150) to interpret the user's statement into a logical statement comprehensible by the rational unit; these modules implement therefore a natural language communications layer.

4. Implementation process according to claim 1, characterized in that the implementation of mechanisms for implementing the formal model is realized by the rational unit (100), the generation module (160) and comprehension module (150).

5. Conversational rational agent placed as a kernel of a dialogue system and/or as element (agent) of a multiagent system, including:

- a definition of a conceptual architecture,
- a formal specification of different components of this architecture and their combination allowing a

formal model to be obtained,

characterized in that it includes:

▪ a software architecture implementing the formal architecture and containing a rational unit (100) intended to implement mechanisms for implementation of the formal specification, this unit (100) contains for that:

▪ data including predefined axiom schemes and of axiom schemes dependent on the desired application, a knowledge base depending on the application including a semantic network and inter-concepts distances,

▪ an inference engine to implement the formal specification mechanisms by means of data and the knowledge base in order to be able to receive a logical statement, understand it and be able to provide a logical statement in response.

6. Conversational rational agent placed as a kernel of a dialogue system and/or as element (agent) of a multiagent system according to claim 5 characterized in that, the data comprise implementation data of a formal model including:

▪ an implementation layer of rationality axioms, an implementation layer of communication axioms, an implementation layer of cooperation axioms, corresponding respectively to axioms of the formal model.

7. Conversational rational agent placed as a kernel of a dialogue system and/or as an element (agent) of a multiagent system according to claim 5

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characterized in that it includes besides:

- a natural language statement generation module (160) from a logical statement coming from the rational unit (100) and a comprehension module (150) to provide a logical language statement to the rational unit from a natural language statement; these modules thus implement a communications layer in natural language.

8. Man/machine dialogue system, including a conversational agent according to claim 7.

9. Information server characterized in that it include the means to implement a man/machine dialogue system according to claim 8.

10. Multiagent system including communicating agents, each agent including the means to implement an interaction, characterized in that it includes at least one agent where the kernel rests on the implementation of a conversational rational agent according to claim 1.

ABSTRACT OF THE DISCLOSURE

A model and implementation process of a conversational rational agent as a kernel of a dialogue system and/or as an element (agent) of a multiagent system including definition of a conceptual architecture of a conversational rational agent; formal specification of the different components of this architecture and their combination permitting a formal model to be obtained; definition of the software architecture implementing the formal architecture; and definition of implementation mechanisms of the formal specifications, the rational agent being suited both to converse with another agent or with a user of the system through any communication medium.

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MODEL AND IMPLEMENTATION PROCESS OF A CONVERSATIONAL RATIONAL AGENT, SERVER AND MULTIAGENT SYSTEM FOR IMPLEMENTATION.

The invention concerns a model and an implementation process for a conversational rational agent as kernel of a dialogue system or a multiagent system.

The invention applies not only to human/agent interaction systems (man/machine dialogue) but also to agent/agent interaction systems (interagent communication and cooperation).

It applies to information servers.

Although the design of man/machine dialogue systems has been studied seriously for more than thirty years, few systems foreshadowing actual usage are available today.

Most demonstration systems that were developed showed at best the system capacity to concatenate some simple exchanges with a user into a stereotyped structure (configured to a particular task) and to a restricted application framework.

These systems are generally limited to illustrating such and such characteristic of an evolved interaction, such as, for example, the machine's understanding of a more or less complex statement (contextual in oral or written natural language, possibly combined with other communication media) or in certain rather restricted cases to the production of a cooperative response.

These systems are still rather far removed from meeting all the conditions required for natural usage of said systems as the convivial conversing "partners" even in the framework of rather ordinary application.

The reasons for this situation are two fold. On the one hand the design of dialogue systems is a complex undertaking because it accrues the problems related to the design of smart artificial systems and those related to the modeling and the formalization of natural communication. When oral dialogue is of interest, the problems linked to the automatic speech recognition are added to this difficulty.

On the other hand, a lot of works have approached dialogue as an isolated phenomenon that deals with the identification of the external manifestations so that an automatic system may learn them. These works have (either deliberately or not) been completely (or partially) sparse regarding the link between the problems of dialogue and that of system intelligence and therefore a formal in-depth study of the cognitive foundations of dialogue.

We are now going to cover briefly the classical approaches of the dialogue that have been developed up until now.

First, there are the structural approaches that come from either the computer field or the linguistic field. They are interested in the determination of an interaction structure that takes into account the regularities in a dialogue exchange (where the simplest are the adjacent pairs such the questions/answers, suggestions/acceptances).

These approaches form the hypothesis that this

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structure exists and that it may be represented in a finite fashion and that all dialogues or at least a large part among them can be circumscribed therein. Structural approaches consider that the coherency of a dialogue is intrinsic to its structure and thus concentrate cn the co-text (the accompanying text) while more or less directly glossing over the profoundly contextual nature of the communication. These limitations are an irrevocable handicap for any interest in the structural approach as a basis for smart interaction models.

There are also the classic differential approaches.

These approaches, also called guided plans, consider intervention in a communication situation not only as a collection of signals (for example, a word sequence) but also as the observable enactment of communicative action (also called according to context, language or dialogue acts) such as to inform, ask, confirm, commit.

These approaches allow us to have an idea of a powerful potential for the study of communication and specifically cooperative dialogue. However, they rely upon short cuts (that causes them to call upon empirical or structural complements that make them lack robustness) and also upon knowledge usage representations that unfortunately often lead to aberrations.

This filer developed a new approach relying upon rational interaction or the conversational rational agent.

In this new approach this filer tried first to maximize the conviviality of interactions between the users and the automatic services.

`The following publications on the topic may be referred to:

Sadek 91a: Sadek, M.D. [translated from French] Mental attitudes and rational interaction: Toward a formal theory of communication. Computer Doctorate thesis, University of Rennes I, France, 1991.

Sadek 91b: D. Sadek. Dialogue acts are rational plans. Proceedings ESCA Tutorial and Research Workshop on the Structures of Multimodal Dialogue, Maratea, Italy, 1991.

Sadek 92: Sadek, M.D. A study in the logic of intention. Proceedings of the 3rd Conference on Principles of Knowledge Representation and Reasoning (KR'92), pages 462-473, Cambridge, MA, 1992.

Sadek 93: Sadek, M.D. [translated from French] Foundations of dialogue: Rational interaction. Proceedings of the 4th summer school on Natural Language Processing, pages 229-255, Lannion, France, 1993.

Sadek 94a: Sadek, M.D. [translated from French] Mental attitudes and foundation of cooperative behavior. Pavard, B., editor, Cooperative systems: of modeling the design, Octares Eds., pages 93-117, 1994.

Sadek 94b: Sadek, M.D. Communication theory = rationality principles + communicative act models. Proceedings of the AAI'94 Workshop on planning for Interagent Communication, Seattle, WA, 1994.

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Sadek 94c: Sadek, M.D. Towards a theory of belief reconstruction: Application to communication. In (SPECOM94): 251-263.

Sadek et al 94: Sadek, M.D., Ferrieux, A., & Cozannet, A. Towards an artificial agent as the kernel of a spoken dialogue system: A progress report. Proceedings of the AAI'94 Workshop on Integration of Natural Language and Speech Processing, Seattle, WA, 1994.

Sadek et al 95: D. Sadek, P. Bretier, V. Cadoret, A. Cozannet, P. Dupont, A. Ferrieux, & F. Panaget: A cooperative spoken dialogue system based on a rational agent model: A first implementation on the AGS application. Proceedings of the ESCA Tutorial and Research Workshop on Spoken Language Systems, Hanstholm, Denmark, 1995.

Sadek et al 96a: Sadek, M.D., Ferrieux A., Cozannet A., Bretier P., Panaget F., & Simonin J. Effective human-computer cooperative spoken dialogues: The AGS demonstrator. In (ISSD 96) (and also Proceedings ICSLP'96 of, Philadelphia, 1996).

Sadek *et al 97*: M.D. Sadek, P. Bretier, & F. Panaget. ARTIMIS: Natural Dialogue Meets Rational Agency. Proceedings 15th International Joint Conference on Artificial Intelligence (IJCAI'97), Nagoya, Japan, pp. 1030-1035, 1997.

Bretier 95: P. Bretier. [translated from French] The cooperative oral communication: Contribution to the logical modeling and implementation of a conversational rational agent. Computer Science Doctoral Thesis, University of Paris XIII, 1995.

Bretier and al 95: P. Bretier, F. Panaget, & D. Sadek. Integrating linguistic capabilities into the formal model of a rational agent: Application to cooperative spoken dialogue. Proceedings of the AAAI'95 Fall Symposium on Rational Agency, Cambridge, MA, 1995

Bretier & Sadek 95: P. Bretier & D. Sadek. Designing and implementing a theory of rational interaction to be the kernel of a cooperative spoken dialogue system. Proceedings of the AAAI'95 Fall Symposium on Rational Agency, Cambridge, MA, 1995.

The conviviality of interaction arises among other attributes by the system's capacity to negotiate with the user, by its capacity to evaluate requests by taking into account the context, by its capacity to determine the implied intentions of the user and to conduct with him/her a flexible interaction that does not follow one preconceived plan for all occasions.

Such a system must be also capable of providing the user with solutions for which he/she has not explicitly asked but which are nevertheless applicable.

There does not exist at the present time a true smart dialogue system in service for an actual application due to the complexity of each of these tasks and because of the difficulty of gathering together all these features so that the interaction can really be qualified as convivial.

The technology developed by the filer rests on the basic principle, which is: in order for an automatic system to promote smart dialogues properly, this system cannot be simulated by a robot.

More precisely, the conviviality of the dialogue cannot be designed simply as window dressing of a preexisting system: on the contrary, this conviviality must arise naturally from the system's intelligence.

The object of the present invention is the realization of a software agent that is rational by its construction. The addition of appropriate principles renders it both communicative and cooperative.

In addition, the technology developed by the filer equally permits the implementation of a conversational rational agent as a kernel of a dialogue system as well as agent of a multiagent system.

In this second application (multiagent system), the communication between such agents no longer takes place by using natural language but rather a formal language (logical) adapted to interaction capacities of said agents.

The invention more specifically has as its object a model and an implementation process of a conversational rational agent as a kernel of a dialogue system or a multiagent system.

According to the invention, the implementation process of a conversational rational agent as kernel of a dialogue system and/or as an element (agent) of a multiagent system comprises the following stages:

- definition of a conceptual architecture of a conversational rational agent,
- formal specification of the different components of this architecture and their combination allowing a formal model to be obtained, and which is characterized also in that it also includes the stages:

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